Bentley
Advancing Infrastructure



TIME AND TIDE WAIT FOR NO MAN:
THE IMPORTANCE OF STRUCTURAL INTEGRITY

An Oil & Gas IQ report by Tim Haïdar

Oil & Gas iQ

The old adage tells us that: "Time and tide wait for no man." Substitute "man" for "rig" and that turn of phrase is particularly prescient when referring to the exertions and perils that an offshore installation will have to face in a lifetime of service in some of the harshest environments that man has conquered.

In 2001, there were some 7,270 offshore oil and gas installations in existence in the world's oceans[1]. Fifteen years later, there are an estimated 9,000 in operation from the Norwegian Continental Shelf to the Pacific Ocean, with up to half of these dotted across the Gulf of Mexico in shallow to ultra deep water.

With an intended life cycle plan of 20 years from commission, but an operational lifespan expected to surpass that by as much as two decades, the vast majority of the world's oil and gas facilities are now mature assets on mature fields[2].

Asset integrity, the underlying systems of people and processes tasked with allowing a facility to perform its core business functions while safeguarding the tenets of health, safety and environmental compliance, is an intrinsic art in the maintenance of the industry's iron and concrete giants.

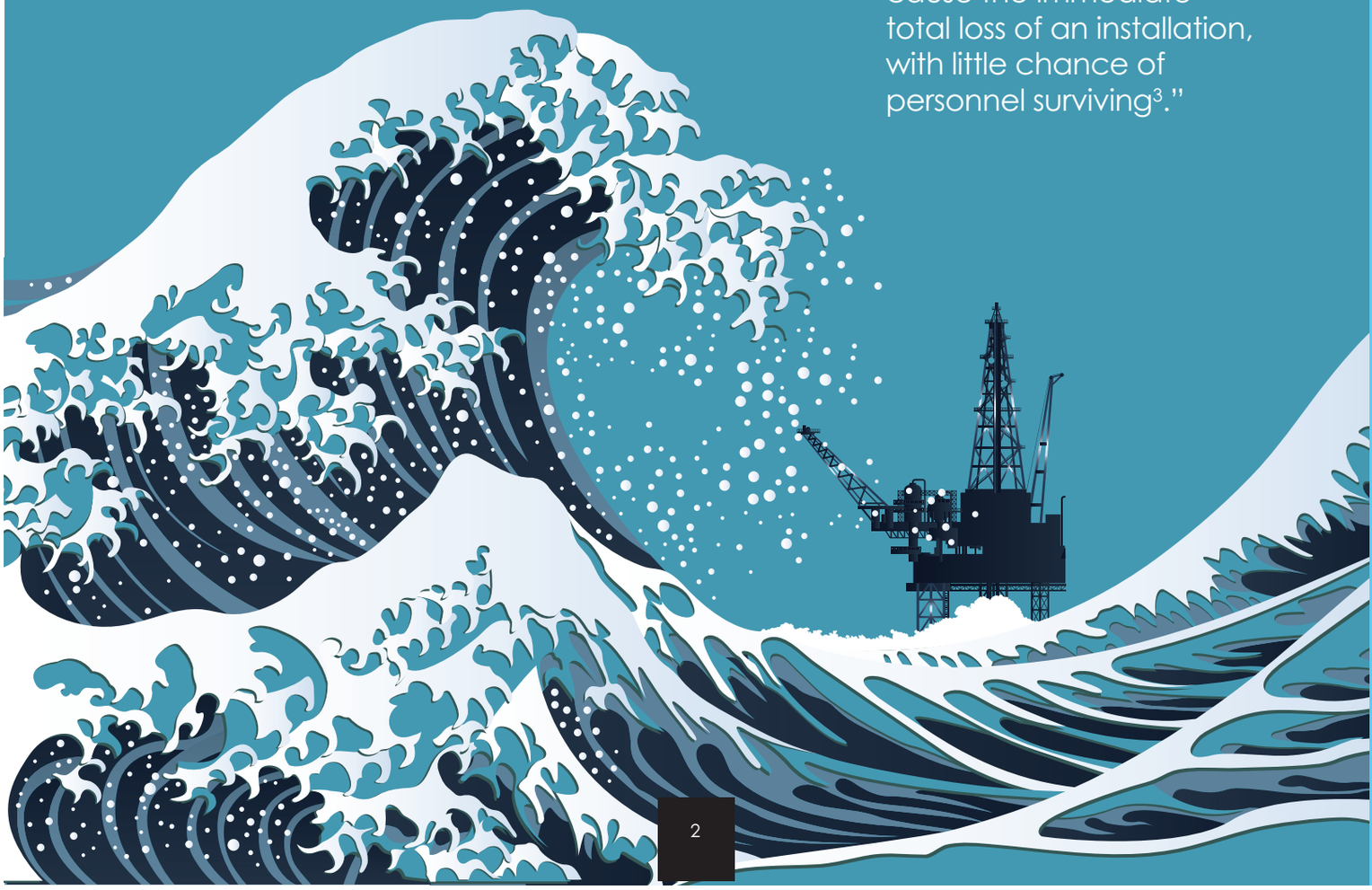
Sitting within this vast and complex web of interconnected functions, structural integrity management (SIM), is a central thread that drives at the core of a successful asset integrity strategy. A simple phrase from the UK's health and safety executive serves as a summation to this effect:

"Structural failure could cause the immediate total loss of an installation, with little chance of personnel surviving[3]."

Two often-cited examples of structural failure in the offshore space serve as stark reminders of exactly what can go wrong when the installations that feed our industry literally go to pieces.

[1] Ferreira and Suslick (2001)
[2] http://halliburtonblog.com/what-is-a-mature-field/
[3] UK HSE Structural integrity strategy 2008-2013, Rev G (2008)

"Structural failure could cause the immediate total loss of an installation, with little chance of personnel surviving[3]."



18379 Bentley eBook3_Layout 1 13/09/2016 16:23 Page 3

Sea Gem, 1965



The first British rig to discovery natural gas in September 1965, Sea Gem was a 5,600 ton steel barge converted by British Petroleum to act as a drilling platform.

Standing on 10 steel legs, the barge could be raised to a height of 15 metres above the surface of the water and then lowered to embark on repositioning.

Two days after Christmas, the facility was being cranked down to sea level for just this purpose, when two of its 10 legs catastrophically failed, causing the rig to capsize. Thirteen of the 32-man crew on board lost their lives in the disaster[4].

Alexander L. Kielland, 1980

Phillips Petroleum employed this pentagon rig as a flotel on the Ekofisk field of the Norwegian Continental Shelf when disaster struck.

One of the horizontal brace supports of one of the semi-subs' five legs snapped, causing a chain reaction that led to the other braces attached to the leg also failing within a matter of seconds. The weakened leg sheared off dumping the platform into the North Sea at a 35 degree angle, partially submerging the deck and accommodation block.

In the chaos that ensued in the 14 minutes after the initial break, 123 of the 212 men aboard perished as the rig went under[5].



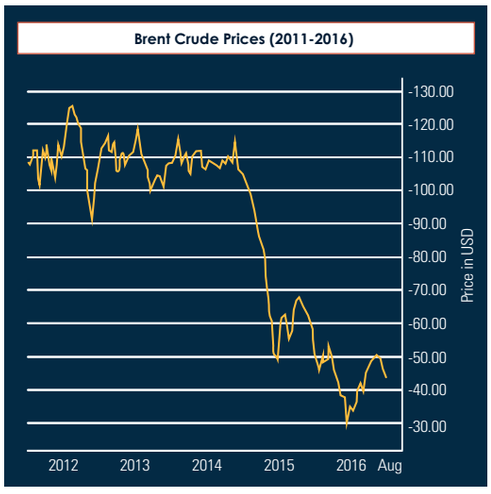
[4] Macondo - Never Say Never Again (2012)
[5] Macondo - Never Say Never Again (2012)

Riding The Current

A lot has changed in the intervening half-century that separates the present day from the Sea Gem disaster that happened during the early years of North Sea oil and gas exploration.

The two catastrophes above have reshaped the way in which the health and safety of personnel are treated. Codes of conduct are now in place to prevent disasters from occurring.

Yet life-threatening situations don't have to come in the form of a 25-metre wave. The graph below is an oil price chart covering the past five years of fluctuations in the Brent Crude market.



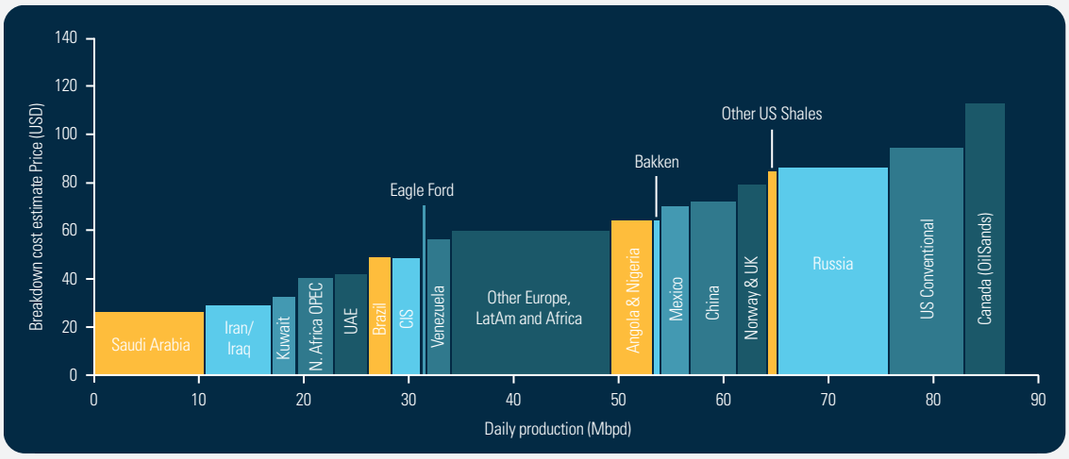
Source: MoneyWeek (2016)

Since Q4 2014, the price of a barrel of oil has nosedived by more than 50 per cent, at one point dipping below the $30 per barrel mark. This is almost a third of the break-even point of some of the world's largest oil producing arenas (see below).

The industry is in the midst of an oil price depression the likes of which the world has not seen for a generation. If we add a prolonged dip in the cost of a barrel to the unavoidable threats of ageing, extreme weather and the hypothetical menace of freak events, asset and structural integrity management are in the spotlight to a greater extent than ever before.

SIM professionals are now addressing the challenges that the oil and gas environment is presenting. To help them face these challenges, Oil and Gas IQ and Bentley Systems have launched an examination into the state of asset integrity.

Phil Christensen, Vice President of Analytical Modelling at Bentley Systems, and Tim Haïdar, Editor in Chief of Oil & Gas IQ, discuss the latest poll results of industry players.

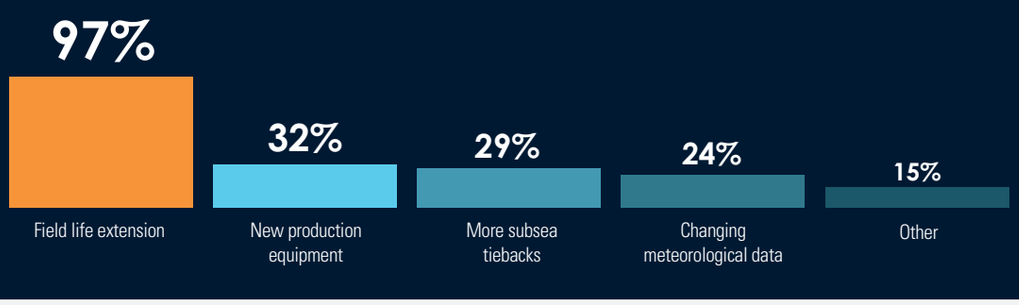


Source: Alliance Bernstein, October 2014

18379 Bentley eBook3_Layout 1 13/09/2016 16:23 Page 5

AT SUB $50 OIL, WHAT ARE YOU INVESTING IN?

What are the most important drivers for asset reassessment?





PHIL CHRISTENSEN

In the current economic environment, there's a greater emphasis on doing more with the assets you have rather than building and deploying new assets. Determining how to get more out of existing assets is a pressing problem for owners and the engineering companies that support them.

In talking with our users, we know that there are many factors that drive that reassessment. Some of them are external and some of them are internal. For example, external drivers include changing meteorological data in many parts of the world, with new wave height regulations coming into play. Changing technologies and the desire to improve output can result in new equipment, which is often heavier and that drives a re-assessment. Of course, getting the most mileage out of a current asset is clearly the optimal choice rather than investing in new assets.

Our survey confirms this, with field life extension clearly the most important business driver. But the other three are just as important especially with respect to adding new equipment to meet changing market and regulatory demands.

When asked how old their platforms were, a third of the respondents said they are less than 10 years old, but **97% of respondents said they are concerned with field-life extensions**. That means they are already thinking about how to get more life out of their assets.

I would have expected it to be **70% or 80%**, so at nearly **100%**, it is even more compelling than we thought.

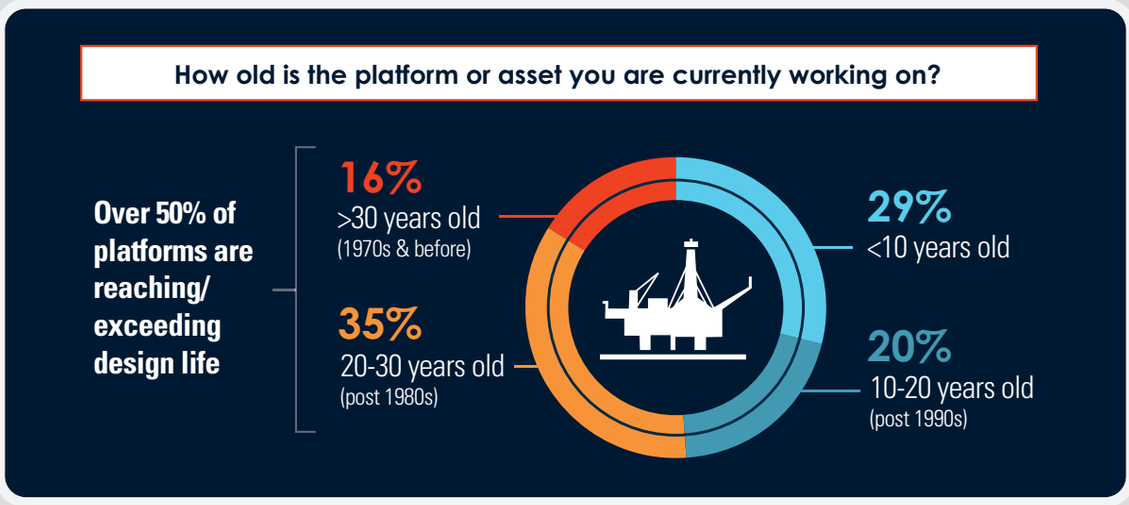
> "It is clear that life extension is a compelling issue for people at the moment."



TIM HAÏDAR

I wonder if we conducted this survey **18 months ago, the percentages might have been more like 60 to 70%.** The current economic situation means it's all about life extension, which means there is very little capital available for new assets.

With **51% of the platforms more than 20 years old**, I would have expected there to be a lesser percentage looking at extending asset life with more people looking toward the decommissioning side of things. We did not ask a specific question about decommissioning and this might show up under "other" in the above question. It does surprise me that this very important factor doesn't seem to be on the radar for these producers at the moment.



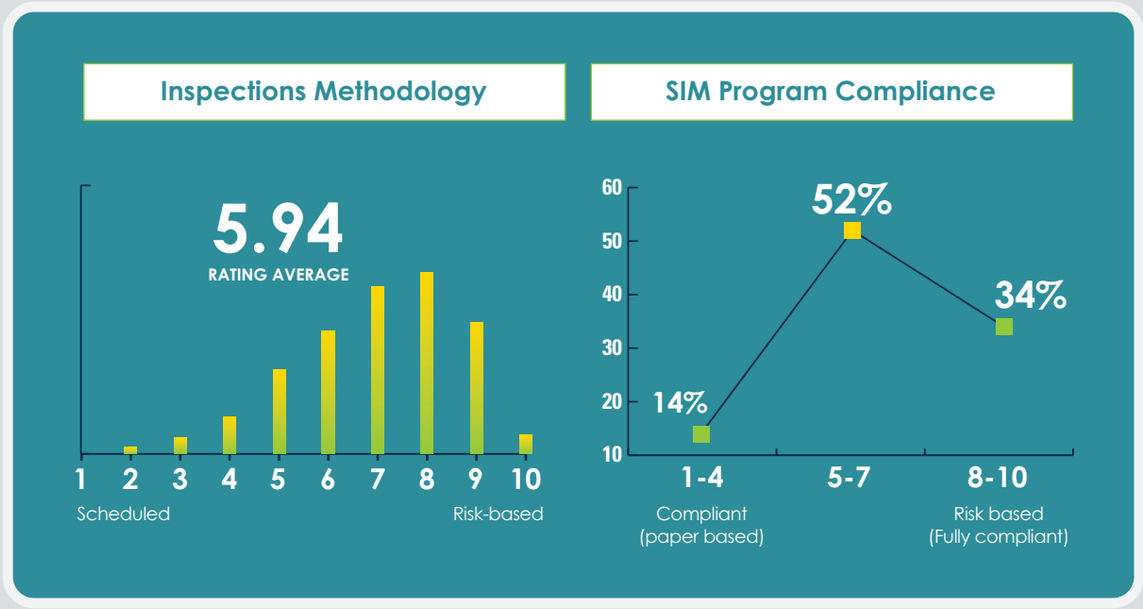


PHIL CHRISTENSEN

The important difference between the questions is the first one is a general question about drivers for re-assessment while the second question is very specific and asks how old is the platform you are you working on right now. So, about half of all the work going on out there is on older platforms.

The takeaway with regard to the second question is, equipment changes and tie-backs are the focus for newer platforms. There should be plenty of life left a 10-year-old platform, but they're certainly making a lot of modifications to eke out more production out of an existing, younger, asset.

> "I would have expected there to be a lesser percentage looking at extending asset life with more people looking toward the decommissioning side of things. We did not ask a specific question about decommissioning and this might show up under "other" in the above question. It does surprise me that this very important factor doesn't seem to be on the radar for these producers at the moment."



> "Thirty-four percent of producers in the risk-based approach end of the spectrum are beyond early adoption."



PHIL CHRISTENSEN

It is evident from this set of statistics that the momentum is now just past the halfway point of adoption of risk-based methodologies. Adoption is continuing, but we still have quite a long way to go until the full risk-based approach is commonplace.

Thirty-four percent in the risk-based approach end of the spectrum are beyond early adoption.

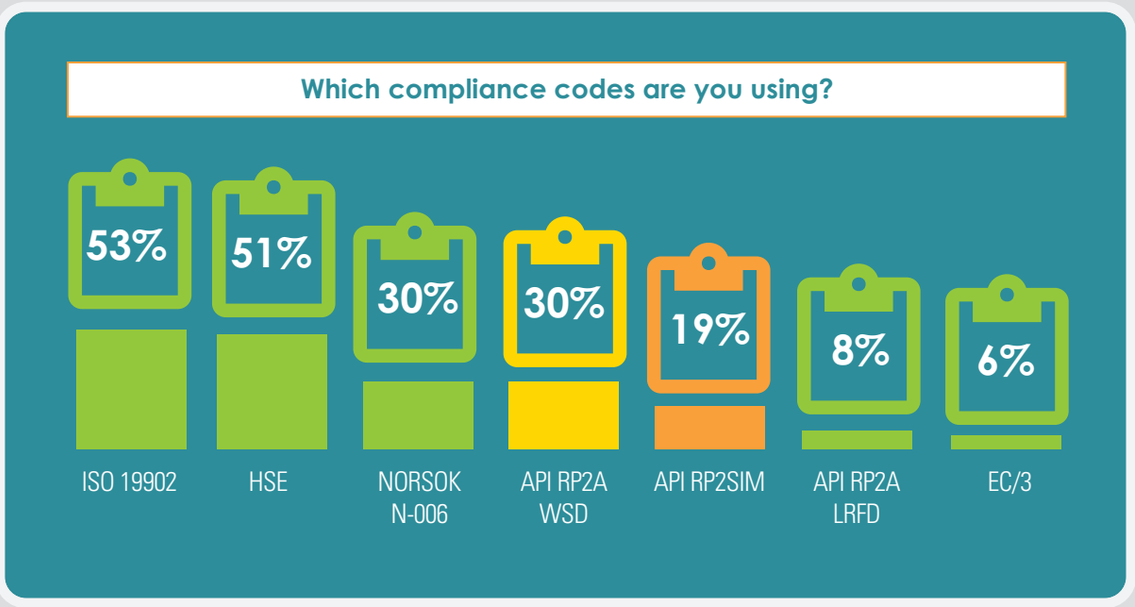
I expected a much larger percentage in that mid-range, rather than the third of people that were between **eight and 10 on that scale**. People have worked out that you can use risk-based inspection (RBI) to reduce costs if it's used properly. You can actually use it to optimise your inspection schedules, and so on. Clearly, people are seeing the business benefit as well as the technical benefit. I think that's the key takeaway for me.

> "Having a better way of assessing conditions and maintaining that as an electronic record to go forward with is a key driver for pushing toward some kind of operational excellence."



TIM HAÏDAR

I think this survey shows that you can't just keep re-inspecting things and wasting money if you didn't really need to inspect it. Having a better way of assessing conditions and maintaining an electronic record to go forward is a key driver for pushing toward some kind of operational excellence.





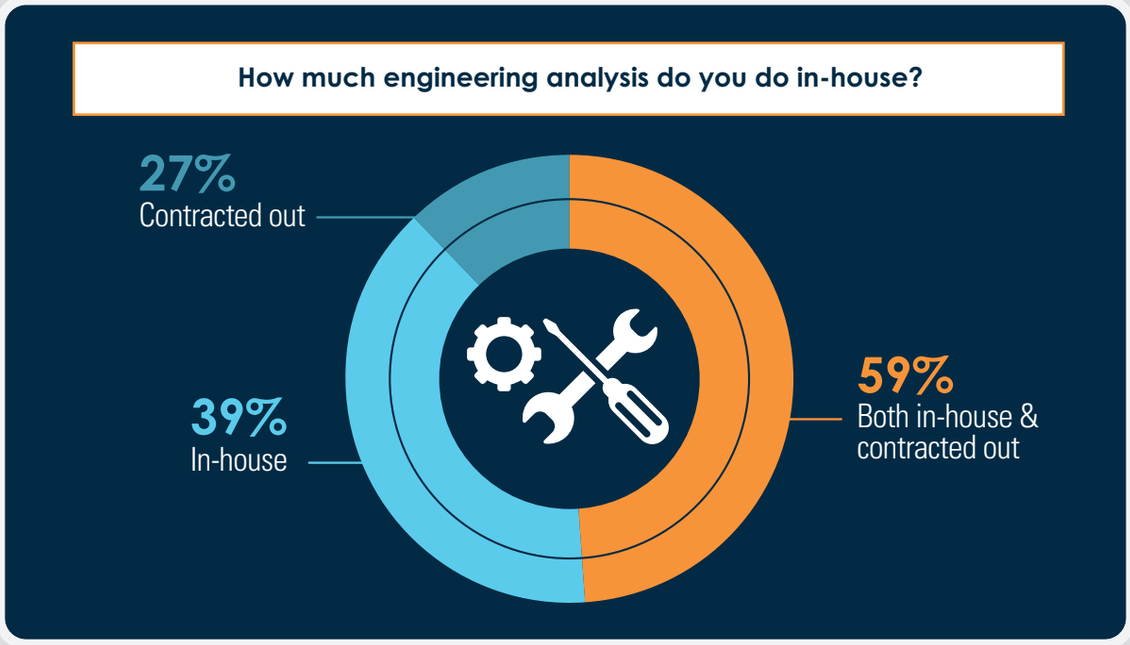
PHIL CHRISTENSEN

The two real takeaways from this graphic are that about half of our respondents were from Europe and the UK based on the HSE and ISO numbers. The other interesting number is the **19% for RP2SIM, a relatively new standard** that came into being in 2014. It is defined as an ongoing process for ensuring the continuing fitness-for-purpose of an offshore structure or fleet of structures.

That process is still in the early adopter stage but will transit into the next phase and a risk-based approach. We can certainly see here that the world of compliance just keeps getting harder, but standards do have the power to push through changes.

The fact that companies are using multiple codes, but some still remain low, shows that the industry has no real desire to move to some of these codes. **The 30% (for API RP2A WSD – working stress design) versus the 8% (for API RP2A LRFD - load and resistance factor design) is meaningful, and the 19% (for RP2 SIM – structural integrity management) versus the 30% (for API RP2A WSD – working stress design) is also meaningful.** This means that working stress is still a preferred approach rather than LRFD (load and resistance factor design) and roughly half of that audience is starting to use the new codes (SIM and WSD).

> “The other interesting number is the 19% for RP2SIM, a relatively new standard that came into being in 2014.”





PHIL CHRISTENSEN

If we assume the audience comprises the usual split for Oil & Gas IQ and **70% of the respondents are from the owner side, this would imply that 9% are still doing all engineering analysis work in-house.**

I'm actually surprised that the percentage doing it all in-house is still that high in the current climate. I know the amount of outsourcing of engineering work that goes on varies from owner to owner, but I still was expecting it to be less. This goes to show that owners obviously see there's a benefit in having that closer overview on what's going on from an engineering perspective, and that they're not prepared to let go of the keys to the car.

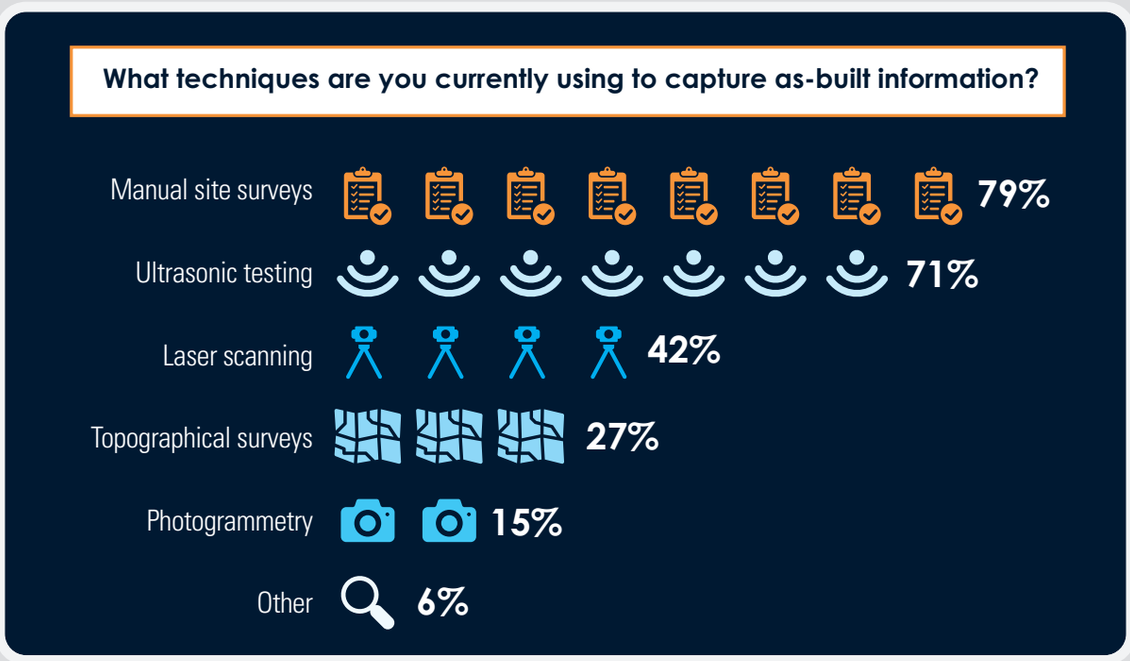
The fact they're keeping that much in-house shows that it's critical to their business, both for management and also productivity improvement. In the current climate and price downturn conditions, it just goes to show that it is not all about the money. If it were, the percentage of outsourcing would be much higher.



TIM HAÏDAR

I found this interesting because in the oil and gas arena, the engineering faculty has, historically, been contracted out to preferred providers. Because of this, it can be seen as a third-party function. The statistics here show that engineering is now being viewed as part of the integrality of a modern, data-focused oil and gas enterprise.

> "Owners obviously see there's a benefit in having that closer overview on what's going on from an engineering perspective, that they're not prepared to let go of the keys to the car."





PHIL CHRISTENSEN

The great majority of people are still doing things by hand. As we digitise further, that **79% statistic means there is a huge potential and opportunity for using mobile technologies.** This could well be the innate conservatism of the industry shining through.

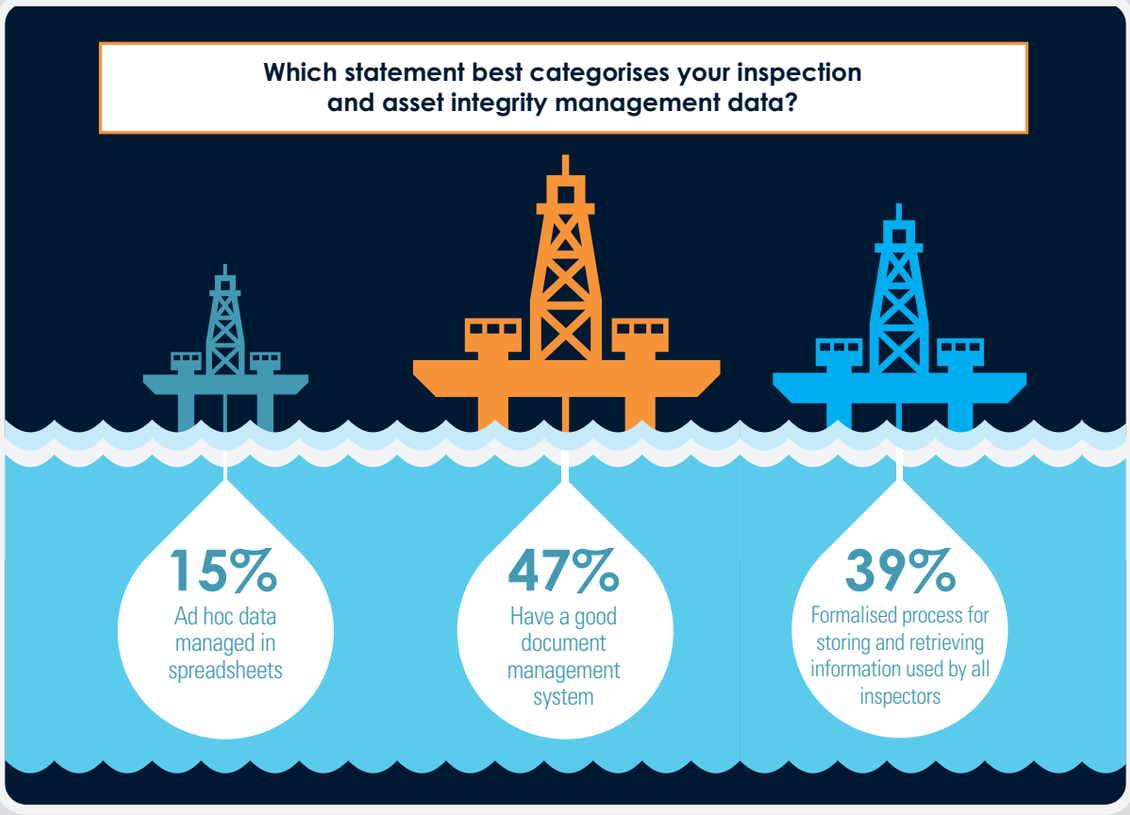
The answers to this question show that four out of five respondents still see the need to be there and physically eyeball what there is in front of them. We see from a question later in the survey that only **32% of the respondents are using mobile devices**. So the opportunities to cut costs and streamline work processes with mobile technology are really big.

We can see that **42% are using laser scanning, 27% are using other surveys, 71% are using ultrasonic methods**, so it's not like there's an unwillingness to adopt new technology.

The survey shows that you can't automate everything. The manual part is still essential and it's going to continue to be essential. What that means is that when we bring in new technologies, they need to complement the manual inspection, not necessarily replace it.

> "Four out of five respondents still see the need to be there and physically eyeball what there is in front of them."

18379 Bentley eBook3_Layout 1 13/09/2016 16:23 Page 11





PHIL CHRISTENSEN

As this is graduated from bottom to top, **47% are really saying that they have a document management system, and we track everything in there.** It's not really a formalised process for managing and retrieving information, but just a repository.

If you want to go down the risk-based approach, which is clearly the trend we're seeing from the other questions, then you do need a more formalised process and that seems to be lacking at the moment.

The other interesting thing is that those who have taken a more formalised process are able to go down the risk-based route that much easier.

Those who are at the mid-way point could be transitioning, and that **47% could be 60% in the next 24 months.** Of course, it is very encouraging for the state of data in the industry that **only 15% of professionals surveyed are stuck in the mud with isolated spreadsheets.**

> "It is very encouraging for the state of data in the industry that only 15% of professionals surveyed are stuck in the mud with isolated spreadsheets."

What is your biggest challenge with regards to optimal structural integrity management?



Poor communication across departmental silos



Contractual issues with service providers



Inconsistent or lack of vision/strategy from senior management in regard to asset life extension decisions



PHIL CHRISTENSEN

Alongside that last question, poor communication stands out as a big issue. Part of the purpose of a formalised process is to ensure that the appropriate notifications happen across the organisation. That's one part of the web of communication that enables an organisation to function effectively.

Communication doesn't just magically happen. It only happens if you make it happen. That's where the real opportunity lies - introducing processes and tools that will encourage that communication.

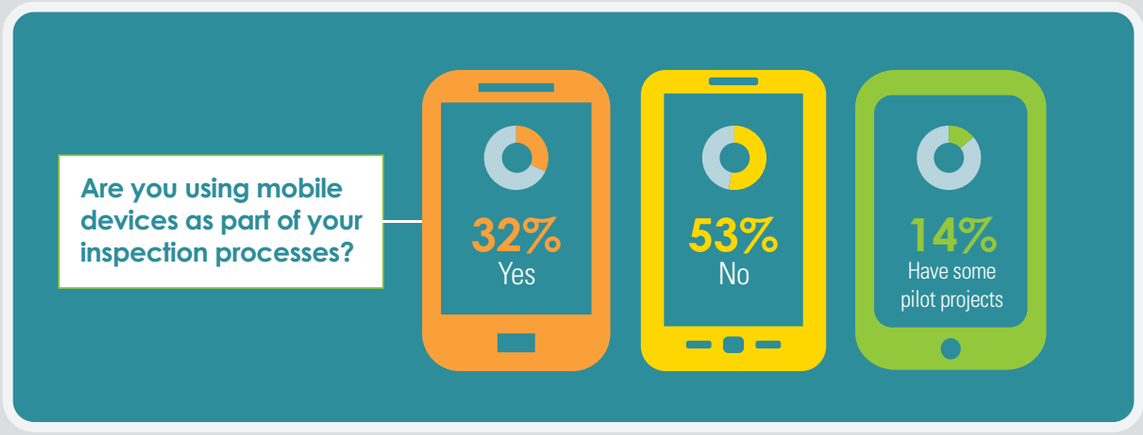


TIM HAÏDAR

I'm not surprised that communication was the major issue here. I actually expected it to be a larger percentage. I expected it to be in the 60s, and that's simply borne out of the experience of running surveys across multiple industry segments with the same discouraging results.

On previous experience, I would also have expected the statistic around "lack of vision" to be much higher than we find here. While it may be concerning that two out of every five respondents works in an organisation where communication is poor, and a third are experiencing inconsistent transmission of a company vision, flip the stats and we have a more positive story: more than half communicate well and more than two-thirds have a transparent view of company strategy.

I would imagine that the stats are better in this case than in prior surveys, as greater visibility of priorities and a focused message are being transmitted down from top management in these hard times.





PHIL CHRISTENSEN

Yes, I think in the industry so far it's the earlier adopters that have adopted mobile technology but the majority of the industry has not, so that's pretty much what I expected.

The 32% is perhaps slightly higher than I expected, but not greatly different. There should be a lot of opportunity for productivity improvement because if producers are not using mobile devices, presumably they are using paper-based workflows, so there's a lot of back office stuff going on. Given the necessity for users to reduce costs in any way possible, there's a ton of opportunity for great cost savings here. There is money being left on the table, so to speak.

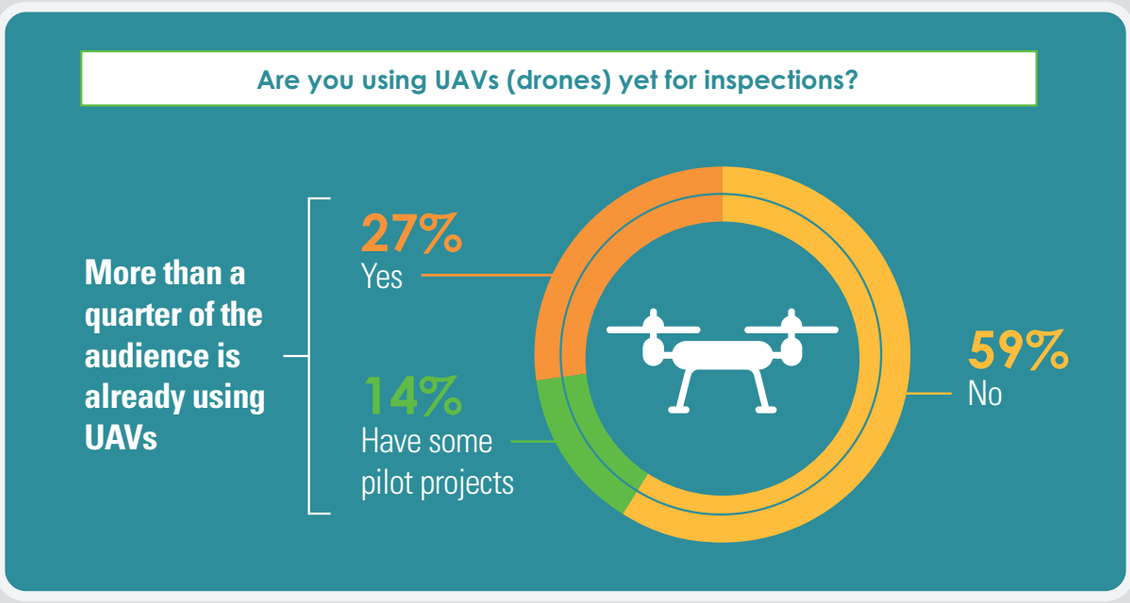
When you're a very early adopter it's usually **less than 20%**. **I think the 32% already using mobile devices and 14% doing pilot projects** is quite a big percentage of people who are proving it's working. We are at the early majority part of the adoption curve. So it should be a faster take-up.

However, in speaking to a couple of inspection companies that are not using any mobile devices, their workflows are paper-based. They are hesitant to adopt mobile devices because they are worried about people dropping them in the water and concerned about how to back up the device when they are out on the platform.

Using consumer-level devices was seen as an option, but the practicalities of using them as you're hanging off a rope over the side of a platform can be problematic.

However, **nearly 50% of companies are using or piloting mobile technologies, so they have overcome these issues**.

> "Given people's desire to have cost savings now, there's a ton of opportunity for great cost savings there."





PHIL CHRISTENSEN

The total was much higher than I expected. I was very surprised that many are already using drones. I thought the usage would be lower than **10%. It is encouraging that people are willing to use this technology.** It would be interesting to know what they do with them, of course. I suspect at the moment that it's just an aid to visual inspection, and they are not doing any sort of image capture.

I doubt there are many people capturing the data and turning it into anything intelligent, but even so that's a very good adoption rate; very encouraging. It shows that the industry's willing to take on new things as long as they're practical and useful.



TIM HAÏDAR

It is interesting that more than a quarter of those surveyed are using this technology, and I think this can be attributed to the fact that it is very easy to buy drones nowadays. The price of drones has plummeted in recent years. They are extremely accessible and cheap, and now have exceptional video quality capabilities at a cost of a few thousand dollars per unit. We also have to be aware that the answer does not attribute "frequency" to usage, so it is vague as to whether UAVs are part of regular inspections toolbox or are seldom employed.

> "The price of drones has plummeted in recent years. They are extremely accessible and cheap, and now have exceptional video quality capabilities at a cost of a few thousand dollars per unit."

18379 Bentley eBook3_Layout 1 13/09/2016 16:24 Page 15

Are you looking toward integrating any of the following technologies in the FUTURE for your structural integrity management programs?



Cloud technology | Mobile devices | Laser scanning/ photogrammetry using UAVs (drones)



PHIL CHRISTENSEN

There is a fairly even spread here across those technologies, but the cloud statistic stands out for me. This tells me we're just getting beyond the early adopter stage for cloud. People are becoming more relaxed about using the cloud and issues of security are becoming less of a concern, and that is encouraging.

Anecdotally, we're seeing an amazing transition at the moment with some of our users asking for "cloud-only" solutions on various products we offer. These are unsolicited requests that specifically demand a solution to their data needs that is not "on-premise." That is proof of how much thinking has changed in just the last three years.

> "We're seeing an amazing transition at the moment with some of our users asking for 'cloud-only' solutions."



TIM HAÏDAR

The thing to bear in mind here is how unlikely that, given the heightened importance of intellectual property and data equating to capital in the digital age, **a company would go 100% cloud friendly.**

However, with fears allayed over security issues since the Stuxnet and Shamoon attacks, the cloud is a cost-effective and increasingly "safer" way to do business than before, hence an increasing uptake.

18379 Bentley eBook3_Layout 1 13/09/2016 16:24 Page 16

A TURNING TIDE?

In the final analysis, we are on the cusp of a seismic shift in the way that structural integrity management is taking place in the oil and gas field.

Those within the business would be the first to point out the bipolarity of an industry that, on the one hand, uses cutting-edge technology to locate and extract oil from thousands of metres beneath the surface of the Earth, yet on the other is so resistant to change that revisions to established practices are looked upon with suspicion.

The results of our investigation into the practices underpinning this crucial part of asset integrity have uncovered that this notoriously conservative sector is embracing technology with increasing rapidity and intent.

The industry is realising that in the 21st century business sphere, a company is only as good as the data it can capture and analyse with the right tools. In a study completed by Bain & Company, those who were actively embracing analytical insights in a big data context were:

> Twice as likely to be in the top quartile of financial performance within their industries
>
> Three times more likely to execute decisions as intended
>
> Five times more likely to make decisions faster[6]

All of which are potential life savers for an industry that is in the throes of a major fiscal upheaval and large-scale restructuring.

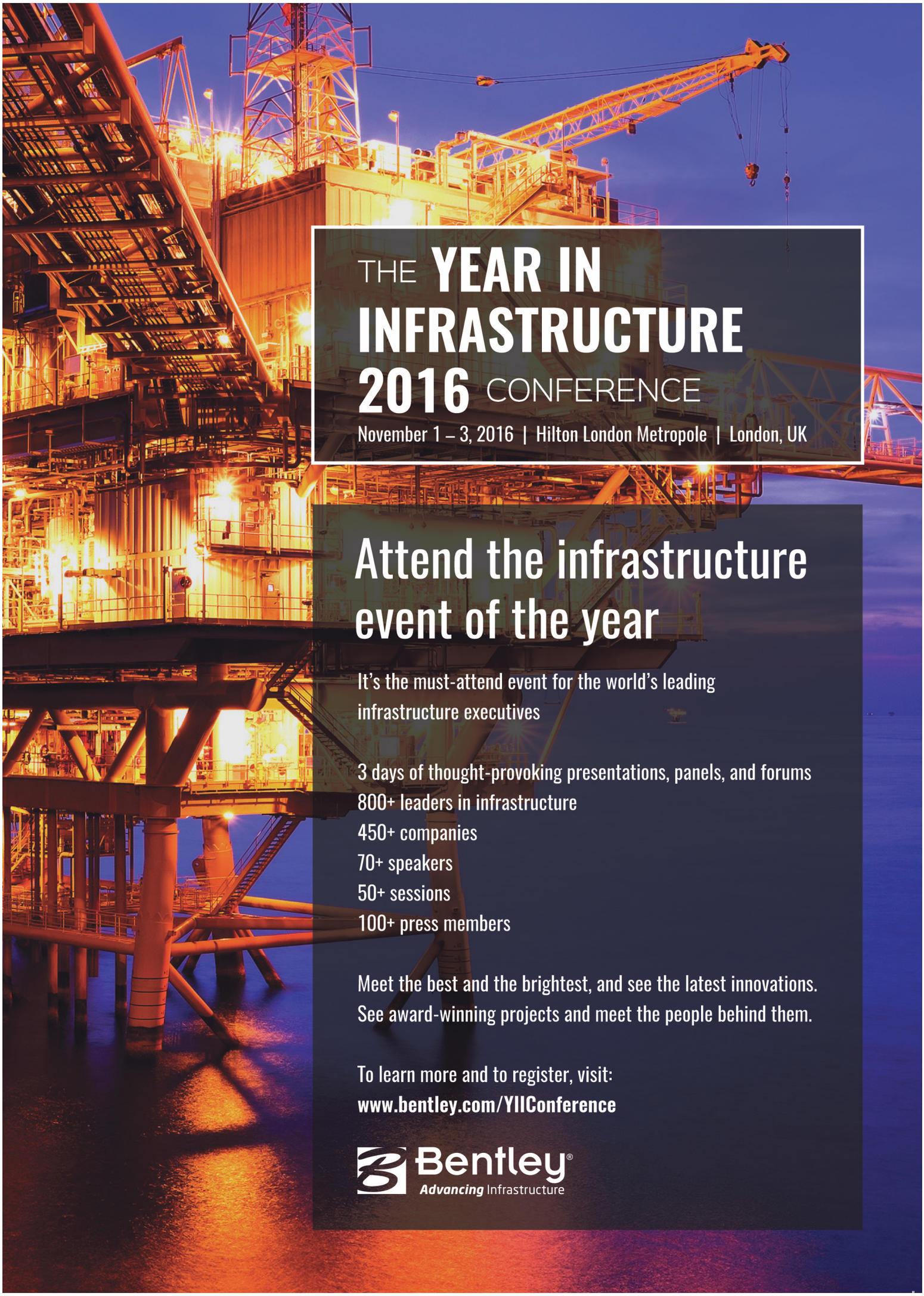
The future is evidently digital, with many companies in the early adoption or transitional phases of systems and devices that are enabling them to have a full-spectrum dominance of the data that makes their organisations tick. Companies are bringing more data-gathering and analysis back in-house as they realise that mastery of the 1s and 0s is the key to maximising the safety and efficacy of ever-ageing assets.

The potential for the growth of this trend is enormous, with recent employee attrition and the looming "Great Crew Change" all pointing to a broader adoption of technology to fill the gaps opened up by falling oil prices and dwindling qualified manpower.

The impetus for a sea change in the way the industry does business has never been more palpable, and, fortunately, the prevailing winds are favourably turning to guide us in the right direction.

[6] Big Data: The Organizational Challenge (2013)

18379 Bentley eBook3_Layout 1 13/09/2016 16:24 Page 17



THE YEAR IN INFRASTRUCTURE 2016 CONFERENCE

November 1 – 3, 2016 | Hilton London Metropole | London, UK

Attend the infrastructure event of the year

It's the must-attend event for the world's leading infrastructure executives

3 days of thought-provoking presentations, panels, and forums
800+ leaders in infrastructure
450+ companies
70+ speakers
50+ sessions
100+ press members

Meet the best and the brightest, and see the latest innovations. See award-winning projects and meet the people behind them.

To learn more and to register, visit:
www.bentley.com/YIIConference

Bentley®
Advancing Infrastructure

18379 Bentley eBook3_Layout 1 13/09/2016 16:24 Page 18

Bentley®
Advancing Infrastructure